

WHAT IS CLAIMED IS:

1 1. A rotation stabilizing device in a
2 microgravitational rotating apparatus, said
3 microgravitational rotating apparatus comprising a casing,
4 a rotary shaft, provided within said casing, having its
5 both ends supported by bearings so as to be rotationally
6 driven by a motor and a plurality of arms, extending
7 radially, having their one ends fitted and supported to
8 said rotary shaft and the other ends fitted with a
9 plurality of boxes in which objects having weight are
10 placed, wherein said rotation stabilizing device
11 comprises a rotation stabilizing means provided between
12 said casing and said plurality of boxes or between an outer
13 side of said casing and a stationary side or between said
14 rotary shaft and said plurality of arms.

1 2. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a flat plate ring shape, fixed to outer
4 circumferential surfaces of said plurality of boxes so as
5 to extend orthogonally to said rotary shaft, a pair of
6 electromagnetic coils, facing each other, fitted to a wall
7 surface of said casing at each of a plurality of places
8 of a circumferential periphery of said fin so that said
9 fin may be interposed between said electromagnetic coils

10 of the pair with a predetermined gap being maintained
11 between said fin and said respective electromagnetic coils
12 of the pair, a gap sensor, detecting variations in said
13 gap, fitted to the wall surface of said casing close to
14 said electromagnetic coils of the pair and a control unit
15 taking detected signals of said gap sensor and comparing
16 said signals with a set value to thereby control exciting
17 current of said electromagnetic coils of the pair existing
18 at the position corresponding to said gap sensor that
19 detected said signals in excess of said set value so that
20 said gap may fall within said set value.

3. A rotation stabilizing device as claimed in Claim 2, wherein said fin, instead of having the flat plate shape, has a frusta-conical shape of which conical surface is inclined with a predetermined angle.

4. A rotation stabilizing device as claimed in Claim 1, wherein said rotation stabilizing means comprises a fin, having a cylindrical shape, fixed to each of upper and lower surfaces of said plurality of boxes so as to extend in the same direction as said rotary shaft, a pair of electromagnetic coils, facing each other, fitted to a wall surface of said casing at each of a plurality of places of a circumferential periphery of said fin so that said fin may be interposed between said electromagnetic coils of the pair with a predetermined gap being maintained

11 between said fin and said respective electromagnetic coils
12 of the pair, a gap sensor, detecting variations in said
13 gap, fitted to the wall surface of said casing close to
14 said electromagnetic coils of the pair and a control unit
15 taking detected signals of said gap sensor and comparing
16 said signals with a set value to thereby control exciting
17 current of said electromagnetic coils of the pair existing
18 at the position corresponding to said gap sensor that
19 detected said signals in excess of said set value so that
20 said gap may fall within said set value.

1 5. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a flat plate ring shape, fixed to outer
4 circumferential surfaces of said plurality of boxes so as
5 to extend orthogonally to said rotary shaft, a pair of
6 electromagnetic coils, facing each other, arranged at each
7 of a plurality of places of a circumferential periphery
8 of said fin so that said fin may be interposed between said
9 electromagnetic coils of the pair with a predetermined gap
10 being maintained between said fin and said respective
11 electromagnetic coils of the pair, a pair of cylinders,
12 fixed to said casing on one hand and connected to said
13 electromagnetic coils of the pair on the other hand so that
14 said electromagnetic coils of the pair may be moved and
15 said gap relative to said fin may be changed, a gap sensor,

16 detecting variations in said gap, fitted to a wall surface
17 of said casing close to said electromagnetic coils of the
18 pair and a control unit taking detected signals of said
19 gap sensor and comparing said signals with a set value to
20 thereby control to drive said cylinders of the pair
21 existing at the position corresponding to said gap sensor
22 that detected said signals in excess of said set value so
23 that said electromagnetic coils of the pair connected to
24 said cylinders may be moved and said gap may fall within
25 said set value.

1 6. A rotation stabilizing device as claimed in
2 Claim 5, wherein said fin, instead of having the flat plate
3 shape, has a frusta-conical shape of which conical surface
4 is inclined with a predetermined angle.

1 7. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a cylindrical shape, fixed to each of upper
4 and lower surfaces of said plurality of boxes so as to
5 extend in the same direction as said rotary shaft, a pair
6 of electromagnetic coils, facing each other, arranged at
7 each of a plurality of places of a circumferential
8 periphery of said fin so that said fin may be interposed
9 between said electromagnetic coils of the pair with a
10 predetermined gap being maintained between said fin and
11 said respective electromagnetic coils of the pair, a pair

12 of cylinders, fixed to said casing on one hand and
13 connected to said electromagnetic coils of the pair on the
14 other hand so that said electromagnetic coils of the pair
15 may be moved and said gap relative to said fin may be changed,
16 a gap sensor, detecting variations in said gap, fitted to
17 a wall surface of said casing close to said electromagnetic
18 coils of the pair and a control unit taking detected
19 signals of said gap sensor and comparing said signals with
20 a set value to thereby control to drive said cylinders of
21 the pair existing at the position corresponding to said
22 gap sensor that detected said signals in excess of said
23 set value so that said electromagnetic coils of the pair
24 connected to said cylinders may be moved and said gap may
25 fall within said set value.

1 8. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a flat plate ring shape, fixed to an inner
4 circumferential wall surface of said casing so as to extend
5 orthogonally to said rotary shaft, a pair of
6 electromagnetic coils, facing each other, fitted to an
7 outer circumferential surface of each of said plurality
8 of boxes so that said fin may be interposed between said
9 electromagnetic coils of the pair with a predetermined gap
10 being maintained between said fin and said respective
11 electromagnetic coils of the pair, a gap sensor, detecting

12 variations in said gap, fitted to the outer
13 circumferential surface of each of said plurality of boxes
14 close to said electromagnetic coils of the pair and a
15 control unit taking detected signals of said gap sensor
16 and comparing said signals with a set value to thereby
17 control exciting current of said electromagnetic coils of
18 the pair existing at the position corresponding to said
19 gap sensor that detected said signals in excess of said
20 set value so that said gap may fall within said set value.

1 9. A rotation stabilizing device as claimed in
2 Claim 8, wherein said fin, instead of having the flat plate
3 shape, has a frusta-conical shape of which conical surface
4 is inclined with a predetermined angle.

1 10. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a cylindrical shape, fixed to each of upper
4 and lower inner wall surfaces of said casing so as to extend
5 in the same direction as said rotary shaft, a pair of
6 electromagnetic coils, facing each other, fitted to each
7 of upper and lower surfaces of said plurality of boxes so
8 that said fin may be interposed between said
9 electromagnetic coils of the pair with a predetermined gap
10 being maintained between said fin and said respective
11 electromagnetic coils of the pair, a gap sensor, detecting
12 variations in said gap, fitted to each of the upper and

13 lower surfaces of said plurality of boxes close to said
14 electromagnetic coils of the pair and a control unit taking
15 detected signals of said gap sensor and comparing said
16 signals with a set value to thereby control exciting
17 current of said electromagnetic coils of the pair existing
18 at the position corresponding to said gap sensor that
19 detected said signals in excess of said set value so that
20 said gap may fall within said set value.

1 11. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a flat plate ring shape, fixed to an inner
4 circumferential wall surface of said casing so as to extend
5 orthogonally to said rotary shaft, a pair of cylinders,
6 facing each other, fitted to each of outer circumferential
7 surfaces of said plurality of boxes, a pair of
8 electromagnetic coils, facing each other, connected to
9 said cylinders of the pair so that said fin may be
10 interposed between said electromagnetic coils of the pair
11 with a predetermined gap being maintained between said fin
12 and said respective electromagnetic coils of the pair as
13 well as so that said gap may be made adjustable, a gap sensor,
14 detecting variations in said gap, fitted to each of the
15 outer circumferential surfaces of said plurality of boxes
16 close to said electromagnetic coils of the pair and a
17 control unit taking detected signals of said gap sensor

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18 and comparing said signals with a set value to thereby
19 control said cylinders of the pair existing at the position
20 corresponding to said gap sensor that detected said
21 signals in excess of said set value so that said gap may
22 fall within said set value.

1 12. A rotation stabilizing device as claimed in
2 Claim 11, wherein said fin, instead of having the flat
3 plate shape, has a frusta-conical shape of which conical
4 surface is inclined with a predetermined angle.

1 13. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means comprises
3 a fin, having a cylindrical shape, fixed to each of upper
4 and lower surfaces of said casing so as to extend in the
5 same direction as said rotary shaft, a pair of cylinders,
6 facing each other, fitted to each of upper and lower
7 surfaces of said plurality of boxes, a pair of
8 electromagnetic coils, facing each other, connected to
9 said cylinders of the pair so that said fin may be
10 interposed between said electromagnetic coils of the pair
11 with a predetermined gap being maintained between said fin
12 and said respective electromagnetic coils of the pair as
13 well as so that said gap may be made adjustable, a gap sensor,
14 detecting variations in said gap, fitted to each of the
15 upper and lower surfaces of said plurality of boxes close
16 to said electromagnetic coils of the pair and a control

17 unit taking detected signals of said gap sensor and
18 comparing said signals with a set value to thereby control
19 said cylinders of the pair existing at the position
20 corresponding to said gap sensor that detected said
21 signals in excess of said set value so that said gap may
22 fall within said set value.

1 14. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means is a
3 vibration isolating device supporting said casing at each
4 of a plurality of places of an outer peripheral portion
5 of said casing and said vibration isolating device
6 comprises a spring mechanism elastically supporting said
7 casing to a stationary side member and an
8 electromagnetically supporting mechanism comprising an
9 exciting coil connected to said spring mechanism to
10 electromagnetically support said spring mechanism to said
11 stationary side member by exciting said exciting coil.

1 15. A rotation stabilizing device as claimed in
2 Claim 14, wherein said vibration isolating device further
3 comprises a gap sensor detecting a gap between said casing
4 and said stationary side member and a control unit taking
5 detected signals of said gap sensor and, in case of
6 detection of said gap in excess of a predetermined range,
7 controlling exciting current of said exciting coil so as
8 to reduce vibration.

1 16. A rotation stabilizing device as claimed in
2 Claim 14, wherein said vibration isolating device further
3 comprises a gap sensor detecting a gap between said casing
4 and said stationary side member and a control unit taking
5 detected signals of said gap sensor to detect signal
6 variations and putting out such drive signals as to cancel
7 said signal variations so that exciting current of said
8 exciting coil may be controlled by said drive signals to
9 thereby control to reduce vibration.

1 17. A rotation stabilizing device as claimed in
2 any of Claims 14 to 16, wherein said spring mechanism
3 comprises a casing side frame member fitted to said casing,
4 a stationary side frame member fitted to said stationary
5 side member and a spring connecting said casing side frame
6 member and said stationary side frame member and said
7 electromagnetically supporting mechanism has said
8 exciting coil fitted to said casing side frame member and
9 comprises a conductor fitted to said stationary side frame
10 member so as to be inserted into said casing side frame
11 member with a predetermined gap being maintained between
12 said conductor and said casing side frame member.

1 18. A rotation stabilizing device as claimed in
2 any of Claims 14 to 17, wherein said spring mechanism uses
3 one or more bar-like rod springs.

1 19. A rotation stabilizing device as claimed in

2 any of Claims 14 to 17, wherein said spring mechanism uses
3 one or more bar-like coil springs.

1 20. A rotation stabilizing device as claimed in
2 any of Claims 14 to 17, wherein said spring mechanism uses
3 one or more members made of rubber, plastics, etc. having
4 a predetermined elasticity.

1 21. A rotation stabilizing device as claimed in
2 Claim 1, wherein said rotation stabilizing means is a
3 safety device interposed between said rotary shaft and
4 said plurality of arms and, if said rotary shaft stops
5 suddenly, said safety device disconnects said rotary shaft
6 and said plurality of arms from each other so that said
7 plurality of arms may rotate freely from said rotary shaft.

1 22. A rotation stabilizing device as claimed in
2 Claim 21, wherein said safety device comprises an actuator
3 fitted within each of said plurality of arms, a pin fitted
4 to an end of a rod of said actuator and a sensor detecting
5 a rotation of said rotary shaft and, when said rod of said
6 actuator elongates to thereby cause said pin of the rod
7 end to engage with a pin hole provided in said rotary shaft,
8 said plurality of arms become rotatable together with said
9 rotary shaft and, if said rotary shaft stops suddenly, said
10 rod is retracted, based on a signal from said sensor, to
11 thereby disengage said pin from said pin hole.

1 23. A rotation stabilizing device as claimed in

Claim 21, wherein said plurality of arms are radially fixed to a connecting shaft, said rotary shaft is separated to an upper rotary shaft and a lower rotary shaft so that said connecting shaft is interposed therebetween, there are provided an actuator fitted within each of said upper and lower rotary shafts, a pin fitted to an end of a rod of said actuator and a sensor detecting a rotation of said rotary shaft and, when said rod of said actuator elongates to thereby cause said pin of the rod end to engage with a pin hole provided in said connecting shaft, said connecting shaft becomes rotatable together with said rotary shaft and, if said rotary shaft stops suddenly, said rod is retracted, based on a signal from said sensor, to thereby disengage said pin from said pin hole.

24. A rotation stabilizing device as claimed in Claim 21, wherein said safety device comprises an actuator, having a rod of which end is formed in a round shape, fitted within each of said plurality of arms, a sensor detecting a rotation of said rotary shaft and an abutting portion, having a recessed round shape that is complementary to the round shape of the rod end of said actuator, provided in said rotary shaft so that the rod end of said actuator may be moved to abut on said abutting portion and, when said rod of said actuator elongates to thereby cause the rod end to abut on said abutting portion of said rotary shaft,

12 said plurality of arms become rotatable together with said
13 rotary shaft and, if said rotary shaft stops suddenly, said
14 rod is retracted, based on a signal from said sensor, to
15 thereby disengage the rod end from said abutting portion.

1 25. A rotation stabilizing device as claimed in
2 Claim 21, wherein said safety device comprises a hole
3 provided in each of said plurality of arms so as to open
4 at an end face thereof, a spring provided at a bottom of
5 said hole, a claw member having its one end activated by
6 said spring and the other end projecting outside said hole
7 and an abutting portion, having a recessed shape that is
8 complementary to a shape of the projecting end of said claw
9 member, provided in said rotary shaft so that the
10 projecting end of said claw member activated by said spring
11 may abut on said abutting portion of said rotary shaft and
12 thereby said plurality of arms are rotatable together with
13 said rotary shaft and, if said rotary shaft stops suddenly,
14 said plurality of arms together with said claw member
15 continue to rotate by inertia force so as to make said claw
16 member disengageable from said abutting portion of said
17 rotary shaft and thereby said plurality of arms are made
18 rotatable freely from said rotary shaft.